PATENT ABSTRACTS OF JAPAN

(11)Publication number : 2002-077003
(43)Date of publication of application : 15.03.2002

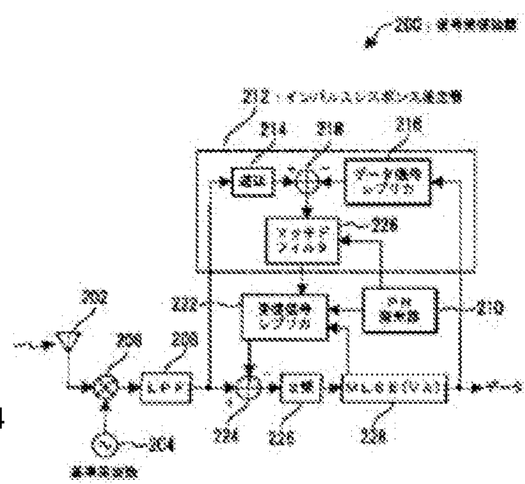
(51)Int.Cl. H04B 7/005
H04L 27/00
H04L 27/34
H04L 27/01

(21)Application number : 2000-256066
(22)Date of filing : 25.08.2000

(71)Applicant : TOYO COMMUN EQUIP CO LTD
(72)Inventor : WADA YOSHIO

(54) SIGNAL RECEIVER

(57)Abstract:
PROBLEM TO BE SOLVED: To provide a signal receiver that can prevent a data transmission rate from being deteriorated.
SOLUTION: The signal receiver 200 extracts only a direct wave from a received signal resulting from multiplexing a data signal and a PN signal and is provided with a PN generator 210 that generates the PN signal, a multiplier 206 that converts the received signal into a base band signal, an impulse response estimate unit 212 that introduces an impulse response estimate value on the basis of the base band signal and the PN signal, a received signal replica generating section 222 that generates a replica of the received signal on the basis of the data signal, the impulse response estimate value and the PN signal, a subtractor 224 that subtracts the replica of the received signal from the base band signal, a square value calculation unit 226 that calculates a square of a subtracted value and a maximum likelihood estimate type equalizer 228 that introduces the data signal on the basis of the square value.



CLAIMS

[Claim(s)]
[Claim 1]A PN signal generating means which is a signal receiving set which takes out only a principal wave from an input signal which multiple-value-ized a data signal and a known PN signal for impulse response presumption, and generates said PN signal, An impulse response estimation means which derives an impulse response point estimate based on a signal conversion means which changes said input signal into a baseband signal, and said baseband signal and said PN signal, An input-signal replica generating means which generates a replica of said input signal based on a data signal, said impulse response point estimate, and said PN signal, The 1st subtraction means that subtracts a replica of said input signal from said baseband signal, A signal receiving set provided with a square value calculating means which computes a square value of a value computed by said 1st subtraction means, and a maximum likelihood sequence estimation type equalization means which derives a data signal based on said square value.
[Claim 2]A PN signal generating means which is a signal receiving set which takes out only a principal wave from an input signal which multiple-value-ized a data signal and a known PN signal for impulse response presumption, and generates said PN signal, The 1st and 2nd reception means that receive said multiple-value-ized signal, and an adding means adding an output value of these 1st and 2nd reception means, A signal conversion means which is provided with a maximum likelihood sequence estimation type equalization means which derives a data signal based on a value computed by said adding means and from which each of said 1st and 2nd reception means changes said input signal into a baseband signal, An impulse response estimation means which derives an impulse response point estimate based on said baseband signal and said PN signal, An input-signal replica generating means which generates a replica of said input signal based on a data signal, said impulse response point estimate, and said PN signal, A signal receiving set provided with the 1st subtraction means that subtracts a replica of said input signal from said baseband signal, and a square value calculating means which outputs a square value of a value computed by said subtraction means as an output value.
[Claim 3]The signal receiving set according to claim 2, wherein said 1st and 2nd reception means are further provided with a weighting means which makes weighting corresponding to a receiving level of said input signal a value computed by said square value calculating means.
[Claim 4]The signal receiving set comprising according to any one of claims 1 to 3:
A delay means from which said impulse response estimation means delays said baseband signal.
A data signal replica generating means which generates a replica of a data signal based on a data signal drawn by said maximum likelihood sequence estimation type equalization means.
The 2nd subtraction means that subtracts a replica of said data signal from a baseband signal

from said delay means.
An impulse response point estimate deriving means which derives said impulse response point estimate based on a value computed by said 2nd subtraction means and said PN signal.

DETAILED DESCRIPTION

[Detailed Description of the Invention]
[0001]
[Field of the Invention]This invention relates to the signal receiving set which takes out only a principal wave from the input signal which multiple-value-ized the data signal and the known PN signal for impulse response presumption.
[0002]
[Description of the Prior Art]As a measure against receiving performance degradation, a signal receiving set is equipped with an impulse response presumption machine and a maximum likelihood sequence estimation type equalizer, the principle of a maximum likelihood sequence estimation detects the optimal data row from the former, and aiming at improvement in receiving performance is performed.
[0003]Drawing 5 is a block diagram showing the example of composition of the conventional signal receiving set. The signal receiving set 500 shown in the figure, It has the antenna 502, the reference frequency generator 504, the multiplier 506, the low pass filter (LPF) 508, the impulse response presumption machine 510, the data signal replica generation machine 512, the subtractor 514, the square value calculation machine 516, and the maximum likelihood sequence estimation type equalizer (MLSE) 518, and is constituted. The binary-phase-modulation method (BPSK:Binary Phase Shift Keying) shall be used for the modulation method.
[0004]A predetermined data frame is transmitted from a signal transmission apparatus (not shown). Although the signal receiving set 502 receives this data frame, it may contain in an input signal the delayed wave in which predetermined [other than a direct wave] carried out symbol time length delay to this direct wave, and amplitude decreased according to the situation of a signal propagation way. Or since it becomes impossible to receive a direct wave when a receiver is located in the shadow of a building, in either of the delayed waves, receiving sensitivity may become high rather than a direct wave. For this reason, if each symbol is judged as it is, an error may arise in a judgment. So, with the signal receiving set 502, it is a principal wave (path of the maximum [receiving sensitivity].) to an input signal by the principle of a maximum likelihood sequence estimation. Even if it is a case where the other delayed wave containing a direct wave are contained, restoration of the original data frame is enabled from an input signal.
[0005]Since detailed explanation is indicated in document "the volume for Shuichi Sasaoka, mobile communications, and Ohm-Sha", it is omitted, but in short, from a signal transmission apparatus, as shown in drawing 6, it transmits the data frame which inserted the PN signal as a training signal in the data signal for transmission and reception with the prescribed interval. The multiplier 506 carries out the multiplication of the reference frequency signal from the office dispatch item generator 504 to the signal which the antenna 502 received, and changes it into a baseband signal.
[0006]By LPF508, the impulse response presumption machine 510 extracts a PN signal from noise rejection and the baseband signal by which waveform shaping was carried out, and derives the time lag and amplitude difference of the PN signal of a principal wave, and PN signals, such as a delayed wave, as an impulse response point estimate.

[0007]The data signal replica generation machine 512 generates the replica of a data signal based on this impulse point estimate and the data signal (restored data) detected by the maximum likelihood sequence estimation type equalizer 518. The subtractor 514 subtracts the replica of a data signal from the baseband signal from LPF508. The square value calculation machine 516 computes the square value of the value computed by the subtractor 514. The maximum likelihood sequence estimation type equalizer 518 detects the optimal data based on the value computed with the square value calculation machine 514.

[0008]

[Problem(s) to be Solved by the Invention]However, as shown in drawing 6, in the method of inserting a PN signal in the data for transmission and reception with a prescribed interval, much time was occupied only for transmission and reception of a PN signal, and there was a problem of causing the fall (fall of a throughput) of the access speed of data.

[0009]This invention solves the above-mentioned conventional problem. The purpose is to provide the signal receiving set which can prevent the fall of the access speed of data.

[0010]

[Means for Solving the Problem]In order to attain the above-mentioned purpose, a signal receiving set of this invention is provided with the following.

It is what takes out only a direct wave from an input signal which multiple-value-ized a data signal and a known PN signal for impulse response presumption, A PN signal generating means which is a signal receiving set which takes out only a direct wave from an input signal which multiple-value-ized a data signal and a known PN signal for impulse response presumption, and generates said PN signal.

A signal conversion means which changes said input signal into a baseband signal.

An impulse response estimation means which derives an impulse response point estimate based on said baseband signal and said PN signal.

An input-signal replica generating means which generates a replica of said input signal based on a data signal, said impulse response point estimate, and said PN signal, The 1st subtraction means that subtracts a replica of said input signal from said baseband signal, a square value calculating means which computes a square value of a value computed by said 1st subtraction means, and a maximum likelihood sequence estimation type equalization means which derives a data signal based on said square value.

[0011]A PN signal generating means which a signal receiving set of this invention takes out only a direct wave from an input signal which multiple-value-ized a data signal and a known PN signal for impulse response presumption, and generates said PN signal, The 1st and 2nd reception means that receive said multiple-value-ized signal, and an adding means adding an output value of these 1st and 2nd reception means, A signal conversion means which is provided with a maximum likelihood sequence estimation type equalization means which derives a data signal based on a value computed by said adding means and from which each of said 1st and 2nd reception means changes said input signal into a baseband signal, An impulse response estimation means which derives an impulse response point estimate based on said baseband signal and said PN signal, An input-signal replica generating means which generates a replica of said input signal based on a data signal, said impulse response point estimate, and said PN signal, It has the 1st subtraction means that subtracts a replica of said input signal from said baseband signal, and a square value calculating means which outputs a square value of a value computed

by said subtraction means as an output value.
[0012]As for said especially 1st and 2nd reception means, it is preferred to have further a weighting means which makes weighting corresponding to a receiving level of said input signal a value computed by said square value calculating means.
[0013]In these cases, said impulse response estimation means, A delay means which delays said baseband signal, and a data signal replica generating means which generates a replica of a data signal based on a data signal drawn by said maximum likelihood sequence estimation type equalization means, The 2nd subtraction means that subtracts a replica of said data signal from a baseband signal from said delay means, It is preferred to have an impulse response point estimate deriving means which derives said impulse response point estimate based on a value computed by said 2nd subtraction means and said PN signal.
[0014]
[Embodiment of the Invention]Hereafter, based on one illustrated embodiment, this invention is explained in detail. Drawing 1 is a figure showing the composition of the data frame sent and received between a signal transmission apparatus and a signal receiving set in this invention. Conventionally, as shown in drawing 6, the data frame is constituted by inserting a PN signal in the data for transmission and reception with a prescribed interval. However, in this invention, as shown in drawing 1, the head of a data frame is only a PN signal, but after this PN signal is what multiple-value-ized the PN signal and the data signal. For this reason, much time is not occupied only for transmission and reception of a PN signal, and it is possible to prevent the fall of the access speed of data.
[0015]Drawing 2 is a block diagram showing an example of the composition of the signal transmission apparatus which transmits a data frame to the signal receiving set of this invention. The signal transmission apparatus 100 shown in the figure is provided with the mapping part 102, PN generator 104, the mapping part 106, the adding machine 108, the low pass filter (LPF) 110, the reference frequency generator 112, the multiplier 114, and the antenna 116, and is constituted.
[0016]The mapping part 102 maps the data of a transmission object. The data of a transmission object is a predetermined data row which consists of 0 and 1, and the mapping part 102 is changed into -1 at the time of +1 and 1, when a data signal is 0, for example.
[0017]PN generator 104 generates a known PN signal. The mapping part 106 maps the PN signal which PN generator 104 generated like the mapping part 102, and when a PN signal is [for example,] 0, it changes it into -1 at the time of +1 and 1.
[0018]The adding machine 108 adds the data signal and PN signal which were mapped. LPF110 performs waveform shaping while removing the noise component of the signal from the adding machine 108. The multiplier 114 is modulated by carrying out the multiplication of the reference frequency from the reference frequency generator 112 to the signal from this LPF110. This modulated signal is transmitted from the antenna 116.
[0019]Drawing 3 is a block diagram showing an example of the composition of the signal receiving set of this invention. The signal receiving set 200 shown in the figure, The antenna 202, the reference frequency generator 204, the multiplier 206, the low pass filter (LPF) 208, PN generator 210, the impulse response presumption machine 212, the input-signal replica generation machine 222, the subtractor 224, the square value calculation machine 226, a maximum likelihood sequence estimation type equalizer. (MLSE) It has 228 and is constituted. The multiplier 206 carries out the multiplication of the reference frequency signal from the reference frequency generator 204 to the signal which the antenna 202 received, and changes it

into a baseband signal.
[0020]The impulse response presumption machine 212 derives an impulse response point estimate based on this baseband signal. This impulse response presumption machine 212 is provided with the delay device 214, the data signal replica generation machine 216, the subtractor 218, and the matched filter 220, and is constituted.
[0021]The delay device 214 delays the baseband signal from LPF208. Although the baseband signal from the delay device 214 and the data signal replica from the data signal replica generating part 216 are inputted into the subtractor 218 mentioned later, this data signal replica needs to be a replica corresponding to the data signal included in the baseband signal from the delay device 214. Then, when the delay device 214 delays a baseband signal, the replica of a baseband signal and the data signal included in this baseband signal is simultaneously inputted into the subtractor 218.
[0022]The data signal replica generation machine 216 generates the replica of the data signal drawn by the maximum likelihood sequence estimation type equalizer 228. The subtractor 218 subtracts the data signal replica from the data signal replica generating part 216 from the baseband signal from the delay device 214. This subtraction removes a data signal ingredient from a baseband signal, and is equivalent to extracting a PN signal ingredient.
[0023]Based on the PN signal ingredient from the subtractor 218, and the known PN signal of PN generator 210, the matched filter 220 draws the time lag and amplitude difference of the PN signal of a direct wave, and the PN signal of a delayed wave, and outputs them as an impulse response point estimate.
[0024]The input-signal replica generating part 222 generates the replica of an input signal based on the data signal drawn by the known PN signal and the maximum likelihood sequence estimation type equalizer 228 of the impulse response point estimate from the matched filter 220, and PN generator 210.
[0025]Specifically, the input-signal replica generating part 222 generates the replica of an input signal by generating a direct wave and a delayed wave from this multiple-value-ized signal, and superimposing these based on an impulse response point estimate, while generating the signal which multiple-value-ized the PN signal and the data signal.
[0026]The subtractor 224 subtracts the input-signal replica from the input-signal replica generating part 222 from the baseband signal from LPF208. The square value calculation machine 226 computes the square value of this subtraction value.
[0027]The maximum likelihood sequence estimation type equalizer 228 derives a data signal by inputting the square value from the square value calculation machine 226, performing calculation processing by a Viterbi algorithm so that this square value may become the minimum, and determining a survival path. Thus, it becomes possible to derive a data signal from the data frame which multiple-value-ized the data signal and the PN signal.
[0028]Next, other embodiments of this invention are described. Drawing 4 is a block diagram showing the modification of the composition of the signal receiving set of this invention. The signal receiving set 300 shown in the figure is provided with the receivers 301 and 401, PN generator 410, the adding machine 428, and the maximum likelihood sequence estimation type equalizer 429, and is constituted.
[0029]The receiver 301 is provided with the antenna 302, the reference frequency generator 304, the multiplier 306, the low pass filter (LPF) 308, the impulse response presumption machine 312, the input-signal replica generation machine 322, the subtractor 324, the square value calculation machine 326, and the weighting section 327, and is constituted. On the other hand, the receiver

401 is provided with the antenna 402, the reference frequency generator 404, the multiplier 406, the low pass filter (LPF) 408, the impulse response presumption machine 412, the input-signal replica generation machine 422, the subtractor 424, the square value calculation machine 426, and the weighting section 427, and is constituted.

[0030]Among these, The antennas 302 and 402, the reference frequency generators 304 and 404, the multipliers 306 and 406, LPF 308 and 408, the impulse response presumption machines 312 and 412, the input-signal replica generation machines 322 and 422, the subtractors 324 and 424, and the square value calculation machines 326 and 426, Antenna [of the signal receiving set 100 shown in drawing 1, respectively] 202, reference frequency generator 204, multiplier 206, and low pass filter LPF08, PN generator 210, the impulse response presumption machine 212, the input-signal replica generation machine 222, the subtractor 224, Since it is the same composition as the square value calculation machine 226, the explanation is omitted.

[0031]The weighting section 327 of the receiver 301 performs weighting corresponding to the receiving level of the signal received by the antenna 302 to the square value computed with the square value calculation machine 326. The weighting section 427 of the receiver 401 performs similarly weighting corresponding to the receiving level of the signal received by the antenna 402 to the square value computed with the square value calculation machine 426.

[0032]For example, when the receiving level of the signal received by the antenna 302 of the receiver 301 is twice the receiving level of the signal received by the antenna 402 of the receiver 401, the weighting section 327 of the receiver 301 should just double the square value which the square value calculation machine 326 computed.

[0033]The adding machine 428 adds the signal from these weighting sections 327 and 427. The maximum likelihood sequence estimation type equalizer 429 derives a data signal by inputting the aggregate value computed by the adding machine 428, performing calculation processing by a Viterbi algorithm so that this aggregate value may become the minimum, and determining a survival path.

[0034]Thus, it becomes possible to derive a data signal from the data frame which multiple-value-ized the data signal and the PN signal. Derivation of the data signal by the maximum likelihood sequence estimation type equalizer 429 can be made more nearly probable by carrying out weighting corresponding to a receiving level to the square value computed with the square value calculation machines 327 and 427.

[0035]In the above, one embodiment of this invention was described over Drawings. However, this invention is not limited to the matter shown in said embodiment, but it is clear for the change, improvement, etc. to be possible based on the description of Claims. For example, in the above-mentioned embodiment, although the impulse response presumption machine was constituted using the matched filter, it may be the means which applied other algorithms, such as an RLS algorithm and an LMS algorithm.

[0036]

[Effect of the Invention]Since the signal which multiple-value-ized the PN signal and the data signal can be received and a data signal can be derived from this signal according to this invention like the above, it becomes possible to prevent the fall of the access speed of data.

TECHNICAL FIELD

[Field of the Invention]This invention relates to the signal receiving set which takes out only a principal wave from the input signal which multiple-value-ized the data signal and the known PN signal for impulse response presumption.

PRIOR ART

[Description of the Prior Art]As a measure against receiving performance degradation, a signal receiving set is equipped with an impulse response presumption machine and a maximum likelihood sequence estimation type equalizer, the principle of a maximum likelihood sequence estimation detects the optimal data row from the former, and aiming at improvement in receiving performance is performed.
[0003]Drawing 5 is a block diagram showing the example of composition of the conventional signal receiving set. The signal receiving set 500 shown in the figure, It has the antenna 502, the reference frequency generator 504, the multiplier 506, the low pass filter (LPF) 508, the impulse response presumption machine 510, the data signal replica generation machine 512, the subtractor 514, the square value calculation machine 516, and the maximum likelihood sequence estimation type equalizer (MLSE) 518, and is constituted. The binary-phase-modulation method (BPSK:Binary Phase Shift Keying) shall be used for the modulation method.
[0004]A predetermined data frame is transmitted from a signal transmission apparatus (not shown). Although the signal receiving set 502 receives this data frame, it may contain in an input signal the delayed wave in which predetermined [other than a direct wave] carried out symbol time length delay to this direct wave, and amplitude decreased according to the situation of a signal propagation way. Or since it becomes impossible to receive a direct wave when a receiver is located in the shadow of a building, in either of the delayed waves, receiving sensitivity may become high rather than a direct wave. For this reason, if each symbol is judged as it is, an error may arise in a judgment. So, with the signal receiving set 502, it is a principal wave (path of the maximum [receiving sensitivity].) to an input signal by the principle of a maximum likelihood sequence estimation. Even if it is a case where the other delayed wave containing a direct wave are contained, restoration of the original data frame is enabled from an input signal.
[0005]Since detailed explanation is indicated in document "the volume for Shuichi Sasaoka, mobile communications, and Ohm-Sha", it is omitted, but in short, from a signal transmission apparatus, as shown in drawing 6, it transmits the data frame which inserted the PN signal as a training signal in the data signal for transmission and reception with the prescribed interval. The multiplier 506 carries out the multiplication of the reference frequency signal from the office dispatch item generator 504 to the signal which the antenna 502 received, and changes it into a baseband signal.
[0006]By LPF508, the impulse response presumption machine 510 extracts a PN signal from noise rejection and the baseband signal by which waveform shaping was carried out, and derives the time lag and amplitude difference of the PN signal of a principal wave, and PN signals, such as a delayed wave, as an impulse response point estimate.
[0007]The data signal replica generation machine 512 generates the replica of a data signal based on this impulse point estimate and the data signal (restored data) detected by the maximum likelihood sequence estimation type equalizer 518. The subtractor 514 subtracts the replica of a data signal from the baseband signal from LPF508. The square value calculation machine 516 computes the square value of the value computed by the subtractor 514. The maximum

likelihood sequence estimation type equalizer 518 detects the optimal data based on the value computed with the square value calculation machine 514.

EFFECT OF THE INVENTION

[Effect of the Invention]Since the signal which multiple-value-ized the PN signal and the data signal can be received and a data signal can be derived from this signal according to this invention like the above, it becomes possible to prevent the fall of the access speed of data.

TECHNICAL PROBLEM

[Problem(s) to be Solved by the Invention]However, as shown in drawing 6, in the method of inserting a PN signal in the data for transmission and reception with a prescribed interval, much time was occupied only for transmission and reception of a PN signal, and there was a problem of causing the fall (fall of a throughput) of the access speed of data.
[0009]This invention solves the above-mentioned conventional problem. The purpose is to provide the signal receiving set which can prevent the fall of the access speed of data.

MEANS

[Means for Solving the Problem]In order to attain the above-mentioned purpose, a signal receiving set of this invention is provided with the following.
It is what takes out only a direct wave from an input signal which multiple-value-ized a data signal and a known PN signal for impulse response presumption, A PN signal generating means which is a signal receiving set which takes out only a direct wave from an input signal which multiple-value-ized a data signal and a known PN signal for impulse response presumption, and generates said PN signal.
A signal conversion means which changes said input signal into a baseband signal.
An impulse response estimation means which derives an impulse response point estimate based on said baseband signal and said PN signal.
An input-signal replica generating means which generates a replica of said input signal based on a data signal, said impulse response point estimate, and said PN signal, The 1st subtraction means that subtracts a replica of said input signal from said baseband signal, a square value calculating means which computes a square value of a value computed by said 1st subtraction means, and a maximum likelihood sequence estimation type equalization means which derives a data signal based on said square value.

[0011]A PN signal generating means which a signal receiving set of this invention takes out only a direct wave from an input signal which multiple-value-ized a data signal and a known PN signal for impulse response presumption, and generates said PN signal, The 1st and 2nd reception means that receive said multiple-value-ized signal, and an adding means adding an output value of these 1st and 2nd reception means, A signal conversion means which is provided with a maximum likelihood sequence estimation type equalization means which derives a data signal based on a value computed by said adding means and from which each of said 1st and 2nd reception means changes said input signal into a baseband signal, An impulse response estimation means which derives an impulse response point estimate based on said baseband

signal and said PN signal, An input-signal replica generating means which generates a replica of said input signal based on a data signal, said impulse response point estimate, and said PN signal, It has the 1st subtraction means that subtracts a replica of said input signal from said baseband signal, and a square value calculating means which outputs a square value of a value computed by said subtraction means as an output value.
[0012]As for said especially 1st and 2nd reception means, it is preferred to have further a weighting means which makes weighting corresponding to a receiving level of said input signal a value computed by said square value calculating means.
[0013]In these cases, said impulse response estimation means, A delay means which delays said baseband signal, and a data signal replica generating means which generates a replica of a data signal based on a data signal drawn by said maximum likelihood sequence estimation type equalization means, The 2nd subtraction means that subtracts a replica of said data signal from a baseband signal from said delay means, It is preferred to have an impulse response point estimate deriving means which derives said impulse response point estimate based on a value computed by said 2nd subtraction means and said PN signal.
[0014]
[Embodiment of the Invention]Hereafter, based on one illustrated embodiment, this invention is explained in detail. Drawing 1 is a figure showing the composition of the data frame sent and received between a signal transmission apparatus and a signal receiving set in this invention. Conventionally, as shown in drawing 6, the data frame is constituted by inserting a PN signal in the data for transmission and reception with a prescribed interval. However, in this invention, as shown in drawing 1, the head of a data frame is only a PN signal, but after this PN signal is what multiple-value-ized the PN signal and the data signal. For this reason, much time is not occupied only for transmission and reception of a PN signal, and it is possible to prevent the fall of the access speed of data.
[0015]Drawing 2 is a block diagram showing an example of the composition of the signal transmission apparatus which transmits a data frame to the signal receiving set of this invention. The signal transmission apparatus 100 shown in the figure is provided with the mapping part 102, PN generator 104, the mapping part 106, the adding machine 108, the low pass filter (LPF) 110, the reference frequency generator 112, the multiplier 114, and the antenna 116, and is constituted.
[0016]The mapping part 102 maps the data of a transmission object. The data of a transmission object is a predetermined data row which consists of 0 and 1, and the mapping part 102 is changed into -1 at the time of +1 and 1, when a data signal is 0, for example.
[0017]PN generator 104 generates a known PN signal. The mapping part 106 maps the PN signal which PN generator 104 generated like the mapping part 102, and when a PN signal is [for example,] 0, it changes it into -1 at the time of +1 and 1.
[0018]The adding machine 108 adds the data signal and PN signal which were mapped. LPF110 performs waveform shaping while removing the noise component of the signal from the adding machine 108. The multiplier 114 is modulated by carrying out the multiplication of the reference frequency from the reference frequency generator 112 to the signal from this LPF110. This modulated signal is transmitted from the antenna 116.
[0019]Drawing 3 is a block diagram showing an example of the composition of the signal receiving set of this invention. The signal receiving set 200 shown in the figure, The antenna 202, the reference frequency generator 204, the multiplier 206, the low pass filter (LPF) 208, PN generator 210, the impulse response presumption machine 212, the input-signal replica

generation machine 222, the subtractor 224, the square value calculation machine 226, a maximum likelihood sequence estimation type equalizer. (MLSE) It has 228 and is constituted. The multiplier 206 carries out the multiplication of the reference frequency signal from the reference frequency generator 204 to the signal which the antenna 202 received, and changes it into a baseband signal.
[0020]The impulse response presumption machine 212 derives an impulse response point estimate based on this baseband signal. This impulse response presumption machine 212 is provided with the delay device 214, the data signal replica generation machine 216, the subtractor 218, and the matched filter 220, and is constituted.
[0021]The delay device 214 delays the baseband signal from LPF208. Although the baseband signal from the delay device 214 and the data signal replica from the data signal replica generating part 216 are inputted into the subtractor 218 mentioned later, this data signal replica needs to be a replica corresponding to the data signal included in the baseband signal from the delay device 214. Then, when the delay device 214 delays a baseband signal, the replica of a baseband signal and the data signal included in this baseband signal is simultaneously inputted into the subtractor 218.
[0022]The data signal replica generation machine 216 generates the replica of the data signal drawn by the maximum likelihood sequence estimation type equalizer 228. The subtractor 218 subtracts the data signal replica from the data signal replica generating part 216 from the baseband signal from the delay device 214. This subtraction removes a data signal ingredient from a baseband signal, and is equivalent to extracting a PN signal ingredient.
[0023]Based on the PN signal ingredient from the subtractor 218, and the known PN signal of PN generator 210, the matched filter 220 draws the time lag and amplitude difference of the PN signal of a direct wave, and the PN signal of a delayed wave, and outputs them as an impulse response point estimate.
[0024]The input-signal replica generating part 222 generates the replica of an input signal based on the data signal drawn by the known PN signal and the maximum likelihood sequence estimation type equalizer 228 of the impulse response point estimate from the matched filter 220, and PN generator 210.
[0025]Specifically, the input-signal replica generating part 222 generates the replica of an input signal by generating a direct wave and a delayed wave from this multiple-value-ized signal, and superimposing these based on an impulse response point estimate, while generating the signal which multiple-value-ized the PN signal and the data signal.
[0026]The subtractor 224 subtracts the input-signal replica from the input-signal replica generating part 222 from the baseband signal from LPF208. The square value calculation machine 226 computes the square value of this subtraction value.
[0027]The maximum likelihood sequence estimation type equalizer 228 derives a data signal by inputting the square value from the square value calculation machine 226, performing calculation processing by a Viterbi algorithm so that this square value may become the minimum, and determining a survival path. Thus, it becomes possible to derive a data signal from the data frame which multiple-value-ized the data signal and the PN signal.
[0028]Next, other embodiments of this invention are described. Drawing 4 is a block diagram showing the modification of the composition of the signal receiving set of this invention. The signal receiving set 300 shown in the figure is provided with the receivers 301 and 401, PN generator 410, the adding machine 428, and the maximum likelihood sequence estimation type equalizer 429, and is constituted.

[0029]The receiver 301 is provided with the antenna 302, the reference frequency generator 304, the multiplier 306, the low pass filter (LPF) 308, the impulse response presumption machine 312, the input-signal replica generation machine 322, the subtractor 324, the square value calculation machine 326, and the weighting section 327, and is constituted. On the other hand, the receiver 401 is provided with the antenna 402, the reference frequency generator 404, the multiplier 406, the low pass filter (LPF) 408, the impulse response presumption machine 412, the input-signal replica generation machine 422, the subtractor 424, the square value calculation machine 426, and the weighting section 427, and is constituted.
[0030]Among these, The antennas 302 and 402, the reference frequency generators 304 and 404, the multipliers 306 and 406, LPF 308 and 408, the impulse response presumption machines 312 and 412, the input-signal replica generation machines 322 and 422, the subtractors 324 and 424, and the square value calculation machines 326 and 426, Antenna [of the signal receiving set 100 shown in drawing 1, respectively] 202, reference frequency generator 204, multiplier 206, and low pass filter LPF08, PN generator 210, the impulse response presumption machine 212, the input-signal replica generation machine 222, the subtractor 224, Since it is the same composition as the square value calculation machine 226, the explanation is omitted.
[0031]The weighting section 327 of the receiver 301 performs weighting corresponding to the receiving level of the signal received by the antenna 302 to the square value computed with the square value calculation machine 326. The weighting section 427 of the receiver 401 performs similarly weighting corresponding to the receiving level of the signal received by the antenna 402 to the square value computed with the square value calculation machine 426.
[0032]For example, when the receiving level of the signal received by the antenna 302 of the receiver 301 is twice the receiving level of the signal received by the antenna 402 of the receiver 401, the weighting section 327 of the receiver 301 should just double the square value which the square value calculation machine 326 computed.
[0033]The adding machine 428 adds the signal from these weighting sections 327 and 427. The maximum likelihood sequence estimation type equalizer 429 derives a data signal by inputting the aggregate value computed by the adding machine 428, performing calculation processing by a Viterbi algorithm so that this aggregate value may become the minimum, and determining a survival path.
[0034]Thus, it becomes possible to derive a data signal from the data frame which multiple-value-ized the data signal and the PN signal. Derivation of the data signal by the maximum likelihood sequence estimation type equalizer 429 can be made more nearly probable by carrying out weighting corresponding to a receiving level to the square value computed with the square value calculation machines 327 and 427.
[0035]In the above, one embodiment of this invention was described over Drawings. However, this invention is not limited to the matter shown in said embodiment, but it is clear for the change, improvement, etc. to be possible based on the description of Claims. For example, in the above-mentioned embodiment, although the impulse response presumption machine was constituted using the matched filter, it may be the means which applied other algorithms, such as an RLS algorithm and an LMS algorithm.

DESCRIPTION OF DRAWINGS

[Brief Description of the Drawings]
[Drawing 1]In this invention, it is a figure showing the composition of the data frame sent and

received between a signal transmission apparatus and a signal receiving set.
[Drawing 2]It is a block diagram showing an example of the composition of the signal transmission apparatus which transmits a data frame to the signal receiving set of this invention.
[Drawing 3]It is a block diagram showing an example of the composition of the signal receiving set concerning this invention.
[Drawing 4]It is a block diagram showing the modification of the composition of the signal receiving set concerning this invention.
[Drawing 5]It is a block diagram showing the example of composition of the conventional signal receiving set.
[Drawing 6]It is a figure showing the composition of the conventional data frame.
[Description of Notations]
200 Signal receiving set
202 Antenna
204 Reference frequency generator
206 Multiplier
208 LPF
210 PN generator
212 Impulse response presumption machine
214 Delay device
216 Data signal replica generation machine
218 Subtractor
220 Matched filter
222 Input-signal replica generation machine
224 Subtractor
226 Square value calculation machine
228 Maximum likelihood sequence estimation type equalizer

[Translation done.]

(19)日本国特許庁（ＪＰ）

(12) 公 開 特 許 公 報（A）

(11)特許出願公開番号
特開2002－77003
（P2002－77003A）

(43)公開日 平成14年３月15日(2002.3.15)

(51)Int.Cl.⁷	識別記号	ＦＩ	テーマコート゛(参考)
Ｈ０４Ｂ 7/005		Ｈ０４Ｂ 7/005	５Ｋ００４
Ｈ０４Ｌ 27/00		Ｈ０４Ｌ 27/00	Ｂ ５Ｋ０４６
27/34			Ｅ
27/01			Ｋ

審査請求 未請求 請求項の数４ ＯＬ （全 ６ 頁）

(21)出願番号 特願2000－256066(P2000－256066)

(22)出願日 平成12年８月25日(2000.8.25)

(71)出願人 000003104
東洋通信機株式会社
神奈川県高座郡寒川町小谷２丁目１番１号

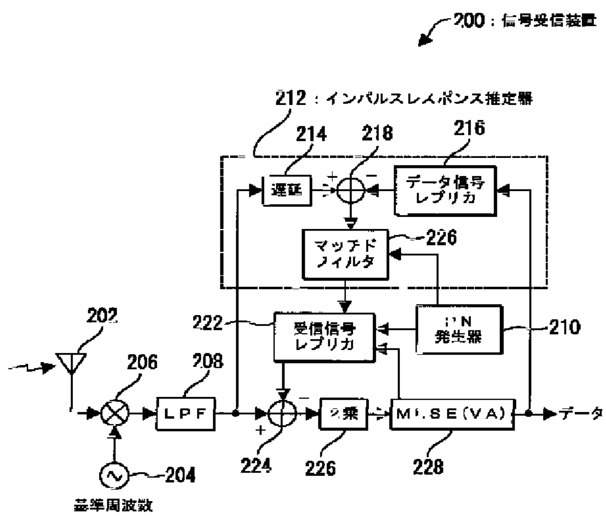
(72)発明者 和田 善生
神奈川県高座郡寒川町小谷２丁目１番１号
東洋通信機株式会社内

(74)代理人 100098039
弁理士 遠藤 恭

Ｆターム(参考) 5K004 AA01 AA05 BB00 BD01 FA03
FD00 FG00
5K046 AA05 EE06 EE32 EE42 EE56
EF05 EF13

(54)【発明の名称】 信号受信装置

(57)【要約】
【課題】データの伝送速度の低下を防止することが可能な信号受信装置を提供する。
【解決手段】信号受信装置２００は、データ信号とＰＮ信号とを多値化した受信信号から直接波のみを取り出すものであり、ＰＮ信号を発生するＰＮ発生器２１０と、受信信号をベースバンド信号に変換する乗算器２０６と、ベースバンド信号とＰＮ信号とに基づいて、インパルスレスポンス推定値を導出するインパルスレスポンス推定器２１２と、データ信号、インパルスレスポンス推定値及びＰＮ信号に基づいて、受信信号のレプリカを生成する受信信号レプリカ生成部２２２と、ベースバンド信号から受信信号レプリカを減算する減算器２２４と、この減算値の２乗値を算出する２乗値算出器２２６と、この２乗値に基づいてデータ信号を導出する最尤系列推定型等化器２２８とを備える。



【特許請求の範囲】

【請求項１】データ信号とインパルスレスポンス推定のための既知のＰＮ信号とを多値化した受信信号から主波のみを取り出す信号受信装置であって、
前記ＰＮ信号を発生するＰＮ信号発生手段と、
前記受信信号をベースバンド信号に変換する信号変換手段と、
前記ベースバンド信号と前記ＰＮ信号とに基づいて、インパルスレスポンス推定値を導出するインパルスレスポンス推定手段と、
データ信号、前記インパルスレスポンス推定値及び前記ＰＮ信号とに基づいて、前記受信信号のレプリカを生成する受信信号レプリカ生成手段と、
前記ベースバンド信号から前記受信信号のレプリカを減算する第１の減算手段と、
前記第１の減算手段によって算出された値の２乗値を算出する２乗値算出手段と、
前記２乗値に基づいてデータ信号を導出する最尤系列推定型等化手段と、を備えることを特徴とする信号受信装置。

【請求項２】データ信号とインパルスレスポンス推定のための既知のＰＮ信号とを多値化した受信信号から主波のみを取り出す信号受信装置であって、
前記ＰＮ信号を発生するＰＮ信号発生手段と、前記多値化した信号を受信する第１及び第２の受信手段と、該第１及び第２の受信手段の出力値を加算する加算手段と、前記加算手段によって算出された値に基づいてデータ信号を導出する最尤系列推定型等化手段とを備え、前記第１及び第２の受信手段のそれぞれが、
前記受信信号をベースバンド信号に変換する信号変換手段と、
前記ベースバンド信号と前記ＰＮ信号とに基づいて、インパルスレスポンス推定値を導出するインパルスレスポンス推定手段と、
データ信号、前記インパルスレスポンス推定値及び前記ＰＮ信号とに基づいて、前記受信信号のレプリカを生成する受信信号レプリカ生成手段と、
前記ベースバンド信号から前記受信信号のレプリカを減算する第１の減算手段と、
前記減算手段によって算出された値の２乗値を出力値として出力する２乗値算出手段と、を備えることを特徴とする信号受信装置。

【請求項３】前記第１及び第２の受信手段は、前記２乗値算出手段によって算出された値に前記受信信号の受信レベルに対応する重み付けをする重み付け手段を更に備えることを特徴とする請求項２に記載の信号受信装置。

【請求項４】前記インパルスレスポンス推定手段は、
前記ベースバンド信号を遅延させる遅延手段と、
前記最尤系列推定型等化手段によって導出されたデータ信号に基づいて、データ信号のレプリカを生成するデータ信号レプリカ生成手段と、
前記遅延手段からのベースバンド信号から前記データ信号のレプリカを減算する第２の減算手段と、
前記第２の減算手段によって算出された値と前記ＰＮ信号とに基づいて前記インパルスレスポンス推定値を導出するインパルスレスポンス推定値導出手段と、を備えることを特徴とする請求項１～３の何れかに記載の信号受信装置。

【発明の詳細な説明】

【０００１】

【発明の属する技術分野】本発明は、データ信号とインパルスレスポンス推定のための既知のＰＮ信号とを多値化した受信信号から主波のみを取り出す信号受信装置に関する。

【０００２】

【従来の技術】従来から、受信性能劣化対策として、信号受信装置にインパルスレスポンス推定器と最尤系列推定型等化器を備え、最尤系列推定の原理により最適なデータ列を検出し、受信性能の向上を図ることが行われている。

【０００３】図5は、従来の信号受信装置の構成例を示すブロック図である。同図に示す信号受信装置５００は、アンテナ５０２、基準周波数発生器５０４、乗算器５０６、ローパスフィルタ（ＬＰＦ）５０８、インパルスレスポンス推定器５１０、データ信号レプリカ生成器５１２、減算器５１４、２乗値算出器５１６、最尤系列推定型等化器（ＭＬＳＥ）５１８を備えて構成される。なお、変調方式には２値位相変調方式（ＢＰＳＫ：Binary Phase Shift Keying ）が用いられているものとする。

【０００４】信号送信装置（図示せず）からは所定のデータフレームが送信される。信号受信装置５０２は、このデータフレームを受信するものであるが、受信信号には、直接波の他に、信号伝搬路の状況に応じて、該直接波に対して所定のシンボル時間長遅延し、且つ振幅が減少した遅延波を含むことがある。あるいは、受信機がビルの影に位置すると直接波が受信できなくなるため、直接波よりも遅延波のいずれかの方が受信感度が高くなる場合もある。このため、そのまま各シンボルの判定を行うと、判定に誤りが生じる場合がある。そこで、信号受信装置５０２では、最尤系列推定の原理により、受信信号に主波（受信感度が最大のパス。直接波を含む）それ以外の遅延波等が含まれている場合であっても、受信信号から元のデータフレームを復元可能とする。

【０００５】詳細な説明は、文献「笹岡秀一編、移動通信、オーム社」に記載されているので省略するが、要するに、信号送信装置からは、図６に示すように、送受対象のデータ信号に所定間隔でトレーニング信号としてのＰＮ信号を挿入したデータフレームを送信する。乗算器５０６は、アンテナ５０２が受信した信号に、局発信号

発生器５０４からの基準周波数信号を乗算し、ベースバンド信号に変換する。

【０００６】インパルスレスポンス推定器５１０は、ＬＰＦ５０８によって雑音除去及び波形整形されたベースバンド信号からＰＮ信号を抽出し、主波のＰＮ信号と遅延波等のＰＮ信号との時間差及び振幅差をインパルスレスポンス推定値として導出する。

【０００７】データ信号レプリカ生成器５１２は、このインパルス推定値と最尤系列推定型等化器５１８によって検出されたデータ信号（復元されたデータ）とに基づいて、データ信号のレプリカを生成する。減算器５１４は、ＬＰＦ５０８からのベースバンド信号からデータ信号のレプリカを減算する。２乗値算出器５１６は、減算器５１４によって算出された値の２乗値を算出する。最尤系列推定型等化器５１８は、２乗値算出器５１４によって算出された値に基づいて、最適なデータを検出する。

【０００８】

【発明が解決しようとする課題】しかしながら、図6に示したように、送受対象のデータに所定間隔でＰＮ信号を挿入する方法では、ＰＮ信号の送受のためだけに多くの時間が占有され、データの伝送速度の低下（スループットの低下）を招くという問題があった。

【０００９】本発明は、上記従来の問題点を解決するものであり、その目的は、データの伝送速度の低下を防止することが可能な信号受信装置を提供することにある。

【００１０】

【課題を解決するための手段】上記目的を達成するため、本発明の信号受信装置は、データ信号とインパルスレスポンス推定のための既知のＰＮ信号とを多値化した受信信号から直接波のみを取り出すものであり、データ信号とインパルスレスポンス推定のための既知のＰＮ信号とを多値化した受信信号から直接波のみを取り出す信号受信装置であって、前記ＰＮ信号を発生するＰＮ信号発生手段と、前記受信信号をベースバンド信号に変換する信号変換手段と、前記ベースバンド信号と前記ＰＮ信号とに基づいて、インパルスレスポンス推定値を導出するインパルスレスポンス推定手段と、データ信号、前記インパルスレスポンス推定値及び前記ＰＮ信号とに基づいて、前記受信信号のレプリカを生成する受信信号レプリカ生成手段と、前記ベースバンド信号から前記受信信号のレプリカを減算する第１の減算手段と、前記第１の減算手段によって算出された値の２乗値を算出する２乗値算出手段と、前記２乗値に基づいてデータ信号を導出する最尤系列推定型等化手段とを備える。

【００１１】また、本発明の信号受信装置は、データ信号とインパルスレスポンス推定のための既知のＰＮ信号とを多値化した受信信号から直接波のみを取り出すものであり、前記ＰＮ信号を発生するＰＮ信号発生手段と、前記多値化した信号を受信する第１及び第２の受信手段と、該第１及び第２の受信手段の出力値を加算する加算手段と、前記加算手段によって算出された値に基づいてデータ信号を導出する最尤系列推定型等化手段とを備え、前記第１及び第２の受信手段のそれぞれが、前記受信信号をベースバンド信号に変換する信号変換手段と、前記ベースバンド信号と前記ＰＮ信号とに基づいて、インパルスレスポンス推定値を導出するインパルスレスポンス推定手段と、データ信号、前記インパルスレスポンス推定値及び前記ＰＮ信号とに基づいて、前記受信信号のレプリカを生成する受信信号レプリカ生成手段と、前記ベースバンド信号から前記受信信号のレプリカを減算する第１の減算手段と、前記減算手段によって算出された値の２乗値を出力値として出力する２乗値算出手段とを備える。

【００１２】特に、前記第１及び第２の受信手段は、前記２乗値算出手段によって算出された値に前記受信信号の受信レベルに対応する重み付けをする重み付け手段を更に備えることが好ましい。

【００１３】また、これらの場合において、前記インパルスレスポンス推定手段は、前記ベースバンド信号を遅延させる遅延手段と、前記最尤系列推定型等化手段によって導出されたデータ信号に基づいて、データ信号のレプリカを生成するデータ信号レプリカ生成手段と、前記遅延手段からのベースバンド信号から前記データ信号のレプリカを減算する第２の減算手段と、前記第２の減算手段によって算出された値と前記ＰＮ信号とに基づいて前記インパルスレスポンス推定値を導出するインパルスレスポンス推定値導出手段とを備えることが好ましい。

【００１４】

【発明の実施の形態】以下、図示した一実施形態に基いて本発明を詳細に説明する。図１は、本発明において、信号送信装置と信号受信装置との間で送受されるデータフレームの構成を示す図である。従来は、図６に示したように、送受対象のデータに所定間隔でＰＮ信号を挿入することによってデータフレームを構成している。しかし、本発明では、図１に示すように、データフレームの先頭はＰＮ信号のみであるが、このＰＮ信号の後はＰＮ信号とデータ信号とを多値化したものになっている。このため、ＰＮ信号の送受のためだけに多くの時間が占有されることがなく、データの伝送速度の低下を防止することが可能になっている。

【００１５】図２は、本発明の信号受信装置に対し、データフレームを送信する信号送信装置の構成の一例を示すブロック図である。同図に示す信号送信装置１００は、マッピング部１０２、ＰＮ発生器１０４、マッピング部１０６、加算器１０８、ローパスフィルタ（ＬＰＦ）１１０、基準周波数発生器１１２、乗算器１１４、アンテナ１１６を備えて構成される。

【００１６】マッピング部１０２は、送信対象のデータをマッピングする。送信対象のデータは、０と１からな

る所定のデータ列であり、マッピング部１０２は、例えばデータ信号が０のときに＋１、１のときに－１に変換する。

【００１７】ＰＮ発生器１０４は、既知のＰＮ信号を発生する。マッピング部１０６は、マッピング部１０２と同様に、ＰＮ発生器１０４が発生したＰＮ信号をマッピングするものであり、例えばＰＮ信号が０のときに＋１、１のときに－１に変換する。

【００１８】加算器１０８は、マッピングされたデータ信号とＰＮ信号とを加算する。ＬＰＦ１１０は、加算器１０８からの信号の雑音成分を除去するとともに、波形整形を行う。乗算器１１４は、このＬＰＦ１１０からの信号に基準周波数発生器１１２からの基準周波数を乗算することによって変調する。この変調された信号がアンテナ１１６から送信される。

【００１９】図３は、本発明の信号受信装置の構成の一例を示すブロック図である。同図に示す信号受信装置２００は、アンテナ２０２、基準周波数発生器２０４、乗算器２０６、ローパスフィルタ（ＬＰＦ）２０８、ＰＮ発生器２１０、インパルスレスポンス推定器２１２、受信信号レプリカ生成器２２２、減算器２２４、２乗値算出器２２６、最尤系列推定型等化器（ＭＬＳＥ）２２８を備えて構成される。　乗算器２０６は、アンテナ２０２が受信した信号に、基準周波数発生器２０４からの基準周波数信号を乗算し、ベースバンド信号に変換する。

【００２０】インパルスレスポンス推定器２１２は、このベースバンド信号に基づいて、インパルスレスポンス推定値を導出するものである。このインパルスレスポンス推定器２１２は、遅延器２１４、データ信号レプリカ生成器２１６、減算器２１８、マッチドフィルタ２２０を備えて構成されている。

【００２１】遅延器２１４は、ＬＰＦ２０８からのベースバンド信号を遅延させる。後述する減算器２１８には、遅延器２１４からのベースバンド信号とデータ信号レプリカ生成部２１６からのデータ信号レプリカとが入力されるが、このデータ信号レプリカは遅延器２１４からのベースバンド信号に含まれるデータ信号に対応するレプリカである必要がある。そこで、遅延器２１４は、ベースバンド信号を遅延させることによって、減算器２１８に、ベースバンド信号とこのベースバンド信号に含まれるデータ信号とのレプリカとが同時に入力されるようにする。

【００２２】データ信号レプリカ生成器２１６は、最尤系列推定型等化器２２８によって導出されたデータ信号のレプリカを生成する。減算器２１８は、遅延器２１４からのベースバンド信号からデータ信号レプリカ生成部２１６からのデータ信号レプリカを減算する。この減算は、ベースバンド信号からデータ信号成分を取り除き、ＰＮ信号成分を抽出することに相当する。

【００２３】マッチドフィルタ２２０は、減算器２１８からのＰＮ信号成分とＰＮ発生器２１０からの既知のＰＮ信号とに基づいて、直接波のＰＮ信号と遅延波のＰＮ信号との時間差及び振幅差を導出し、インパルスレスポンス推定値として出力する。

【００２４】受信信号レプリカ生成部２２２は、マッチドフィルタ２２０からのインパルスレスポンス推定値、ＰＮ発生器２１０からの既知のＰＮ信号及び最尤系列推定型等化器２２８によって導出されたデータ信号とに基づいて、受信信号のレプリカを生成する。

【００２５】具体的には、受信信号レプリカ生成部２２２は、ＰＮ信号とデータ信号とを多値化した信号を生成するとともに、インパルスレスポンス推定値に基づいて、この多値化した信号から直接波と遅延波を生成し、これらを重畳することにより、受信信号のレプリカを生成する。

【００２６】減算器２２４は、ＬＰＦ２０８からのベースバンド信号から受信信号レプリカ生成部２２２からの受信信号レプリカを減算する。２乗値算出器２２６は、この減算値の２乗値を算出する。

【００２７】最尤系列推定型等化器２２８は、２乗値算出器２２６からの２乗値を入力し、この２乗値が最小になるようにビタビアルゴリズムによる算出処理を行い、生き残りパスを決定することにより、データ信号を導出する。このようにして、データ信号とＰＮ信号を多値化したデータフレームからデータ信号を導出することが可能となる。

【００２８】次に、本発明の他の実施形態について説明する。図４は、本発明の信号受信装置の構成の変形例を示すブロック図である。同図に示す信号受信装置３００は、受信機３０１、４０１、ＰＮ発生器４１０、加算器４２８、最尤系列推定型等化器４２９を備えて構成されている。

【００２９】受信機３０１は、アンテナ３０２、基準周波数発生器３０４、乗算器３０６、ローパスフィルタ（ＬＰＦ）３０８、インパルスレスポンス推定器３１２、受信信号レプリカ生成器３２２、減算器３２４、２乗値算出器３２６、重み付け部３２７を備えて構成される。一方、受信機４０１は、アンテナ４０２、基準周波数発生器４０４、乗算器４０６、ローパスフィルタ（ＬＰＦ）４０８、インパルスレスポンス推定器４１２、受信信号レプリカ生成器４２２、減算器４２４、２乗値算出器４２６、重み付け部４２７を備えて構成される。

【００３０】これらのうち、アンテナ３０２、４０２、基準周波数発生器３０４、４０４、乗算器３０６、４０６、ＬＰＦ３０８、４０８、インパルスレスポンス推定器３１２、４１２、受信信号レプリカ生成器３２２、４２２、減算器３２４、４２４、２乗値算出器３２６、４２６は、それぞれ図１に示した信号受信装置１００のアンテナ２０２、基準周波数発生器２０４、乗算器２０６、ローパスフィルタＬＰＦ）０８、ＰＮ発生器２１

0、インパルスレスポンス推定器２１２、受信信号レプリカ生成器２２２、減算器２２４、２乗値算出器２２６と同様の構成であるため、その説明は省略する。

【００３１】受信機３０１の重み付け部３２７は、２乗値算出器３２６によって算出された２乗値に対し、アンテナ３０２によって受信された信号の受信レベルに対応する重み付けを行う。同様に受信機４０１の重み付け部４２７は、２乗値算出器４２６によって算出された２乗値に対し、アンテナ４０２によって受信された信号の受信レベルに対応する重み付けを行う。

【００３２】例えば、受信機３０１のアンテナ３０２によって受信された信号の受信レベルが受信機４０１のアンテナ４０２によって受信された信号の受信レベルの２倍であった場合には、受信機３０１の重み付け部３２７は、２乗値算出器３２６が算出した２乗値を２倍すればよい。

【００３３】加算器４２８は、これら重み付け部３２７、４２７からの信号を加算する。最尤系列推定型等化器４２９は、加算器４２８によって算出された加算値を入力し、この加算値が最小になるようにビタビアルゴリズムによる算出処理を行い、生き残りパスを決定することにより、データ信号を導出する。

【００３４】このようにして、データ信号とＰＮ信号を多値化したデータフレームからデータ信号を導出することが可能となる。また、２乗値算出器３２７、４２７によって算出された２乗値に受信レベルに対応する重み付けを行うことにより、最尤系列推定型等化器４２９によるデータ信号の導出をより確からしいものとすることができる。

【００３５】以上、本発明の一実施形態を図面に沿って説明した。しかしながら本発明は前記実施形態に示した事項に限定されず、特許請求の範囲の記載に基いてその変更、改良等が可能であることは明らかである。例えば、上記の実施形態においては、インパルスレスポンス推定器をマッチドフィルタを用いて構成したが、ＲＬＳアルゴリズムやＬＭＳアルゴリズム等の他のアルゴリズムを適用した手段であってもよい。

【００３６】

【発明の効果】以上の如く本発明によれば、ＰＮ信号とデータ信号とを多値化した信号を受信し、この信号からデータ信号を導出することができるため、データの伝送速度の低下を防止することが可能となる。

【図面の簡単な説明】

【図１】本発明において、信号送信装置と信号受信装置との間で送受されるデータフレームの構成を示す図である。

【図２】本発明の信号受信装置に対し、データフレームを送信する信号送信装置の構成の一例を示すブロック図である。

【図３】本発明に係る信号受信装置の構成の一例を示すブロック図である。

【図４】本発明に係る信号受信装置の構成の変形例を示すブロック図である。

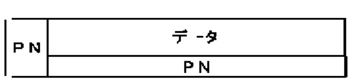
【図５】従来の信号受信装置の構成例を示すブロック図である。

【図６】従来のデータフレームの構成を示す図である。

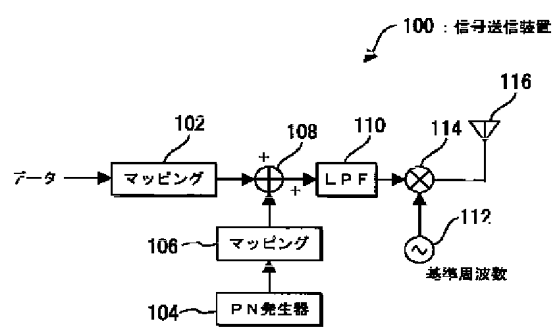
【符号の説明】

２００　信号受信装置
２０２　アンテナ
２０４　基準周波数発生器
２０６　乗算器
２０８　ＬＰＦ
２１０　ＰＮ発生器
２１２　インパルスレスポンス推定器
２１４　遅延器
２１６　データ信号レプリカ生成器
２１８　減算器
２２０　マッチドフィルタ
２２２　受信信号レプリカ生成器
２２４　減算器
２２６　２乗値算出器
２２８　最尤系列推定型等化器

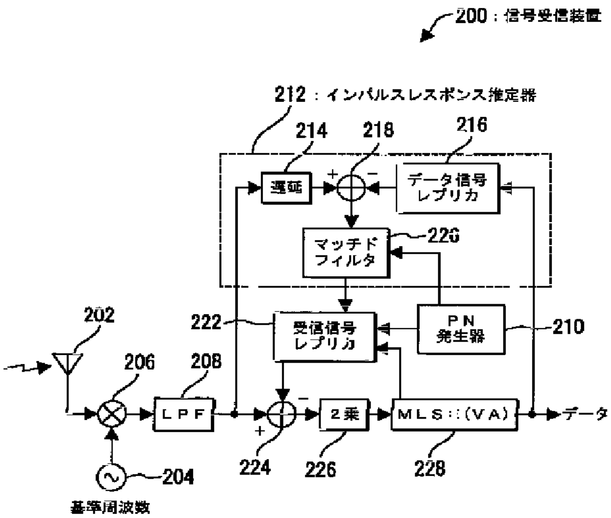
【図１】



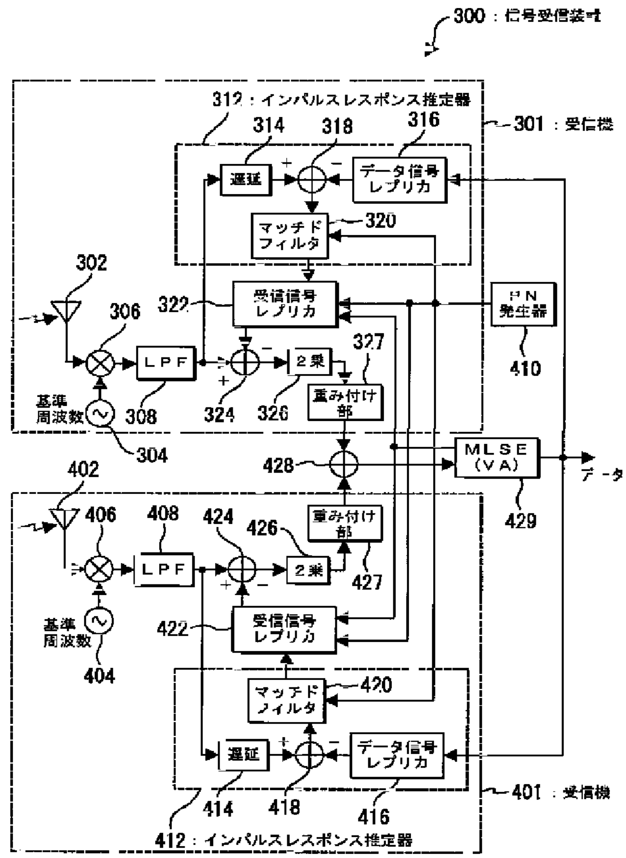
【図２】



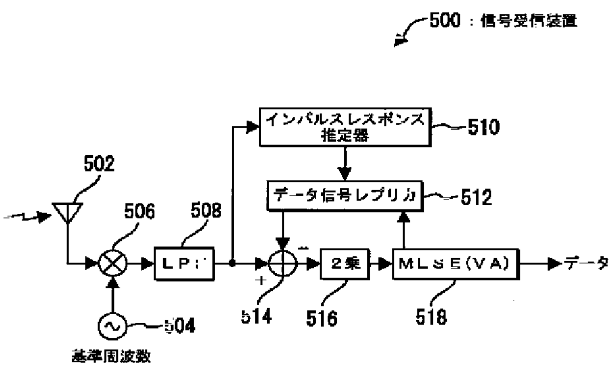
【図3】



【図4】



【図5】



【図6】

PN	データ	PN	データ	PN	データ